Student Number ___ Student Name: ______

University of Saskatchewan

EE 325 Communication Systems I

Quiz #1 - Jan. 29/2001

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Time: 30 minutes - all questions have equal value

Permitted:- text, printed notes, student's own hand-written materials

Use the space below each question for your answer.

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*2.0 A radio frequency transmitter has a preamplifier with voltage gain 15 followed by a power amplifier with gain 16 dB. If the input and load impedances are 50Ω and the preamplifier input voltage is 20 mVrms. What is the output power (in Watts)?

pre Gain = 15   power Gain 16 dB $= 10\log_{10}\left(\frac{P_o}{P_{in}}\right)$ $16 = 10\log_{10}\left(\frac{P_o}{P_{in}}\right)$

20mVrms $40 = \frac{P_o}{P_{in}}$

$P_{in} = \frac{(V_{rms})^2}{R}$ $P_{in} \cdot Gain = P_{out}$? $0.12\,mW \cdot 40 = P_{out}$

$P_{in} = \frac{(20mV)^2}{50\Omega}$ $0.12\,mW\ P_{out} = P_{in}(6\,dB)$ $\boxed{4.78\,mW = P_{out}}$

$P_{in} = 0.008\,mW$ ✓

*2.2 An oscilloscope measures a 500 Hz sinusoid with peak-to-peak voltage of 3.8 volts. Determine the a) normalized power, b) level in dBV and c) level in dBm (600Ω)

a) $P_N = (V_{rms})^2$ b) $20\log_{10}\left(\frac{V_o}{1V_{rms}}\right) = dBV$ c) $P_{in} = \frac{V_{rms}^2}{R}$

$V_{rms} = \frac{3.8V}{\sqrt{2}}\ 2\sqrt{2}$ $20\log_{10}\left(\frac{2.7}{1}\right)$ $= \frac{(2.7V)^2}{600\Omega}$

$= \frac{2.7V}{2}$ $\boxed{8.63\,dBV}$ $= 0.0215\,W$

$P_n = (2.7V)^2$ $-6\,dB$ $P(dBm) = 10\log_{10}\left(\frac{12.15\,mV}{1\,mW}\right)$

$\boxed{P_n = 7.22\,W}$ $\boxed{= 10.8\,dBm}$

4    $-6\,dB$

*2.20 Example 2-14 shows Fourier series components for a 2 kHz square-wave with amplitude ± 2V. **Recalculate the 10 kHz component** to an accuracy of 5 decimal places. (hint: the complete spectrum can be obtained by first adding a 2 volt dc offset then analyzing the resulting 0-4 volt pulse sequence and then removing the zero Hz component (2 volts) from the calculated spectrum).

*3.1 **Drill Problem - A** ... and the following ... (in volts) and com...

Modulation Sign...								
2V cos2π4000t								
4V cos2π11000t								
2V + 4V cos2π23000t	200	3	200	20	200	43		
cos2π4000t + cos2π8000t	50	12	55	16				
Checksum	550	40	550	91	250	67	50	28

A1 $\frac{2\times100}{2}$ R1

$\frac{4\times100}{2}$

$\frac{4\times100}{2}$

$\frac{100}{2}$

*3.4 A baseband color television signal has frequency components ranging from 0.1 Hz to 4.6 MHz. a) What is the theoretical minimum sampling rate that can faithfully reproduce this signal? b) Suggest a practical minimum sampling rate. c) What is the bit rate in the practical case if 8 bit PCM coding is used?

0.1 Hz   4.6 MHz

a) $f_{min} = 2(4.6\,MHz) = 9.2\,MHz$ ✓

b) 20% higher = 11.04 MHz ✓

c) ?

*5.11c A 10 kHz sinusoid is quantized using a 16-bit LPCM encoder/decoder with 44 kHz sampling rate. Assume that sinusoid uses only one-eighth of the encoder voltage range and that the output reconstruction filter has sin x/x correction with 0-22 kHz bandwidth. Determine the SNR of the reconstructed sinusoid. ?

$SNR = N(6.02) + 1.77$ $\frac{\sin x}{x}$ $B_w = 0\text{-}22\,kHz$

a) $= 16(6.02) + 1.77 = 98.09$

b) $SNR = 10\log_{10}($ 3(

END